

## Seasonal Ozone Exposure Mapping at Great Smoky Mountains National Park

### Background

The NPS has monitored ozone concentrations at 4 sites for 5-10 years. These monitoring stations are mostly on the northwest edge of the park. Although there is a range in elevation of the monitoring stations, because of their spatial separation the elevation gradient is only approximate for ozone exposures. The lower elevation sites have large diurnal ozone concentration changes with minimum values near zero while the higher elevation sites have a smaller fluctuation range and ozone remains high overnight.

A 1995 study using passive samplers over a three-week period has been used to show the spatial variability of ozone concentrations within the park. A coarse elevation grid was used to adjust interpolation data between measurement sites to account for the elevation gradient of ozone concentration. The result is a contour map for the whole park estimating ozone exposures during that measurement period. The ozone distribution detail available by this approach is both encouraging in predicting the areas most at risk from ozone exposure and limiting in that the detail is too coarse to pick up some major geological features of the park. There are also several areas where the actual measurements are under-represented and too little detail on ozone elevational gradients, exposure aspect, within canopy vs. open field, and edge effects from terrain and vegetation cover

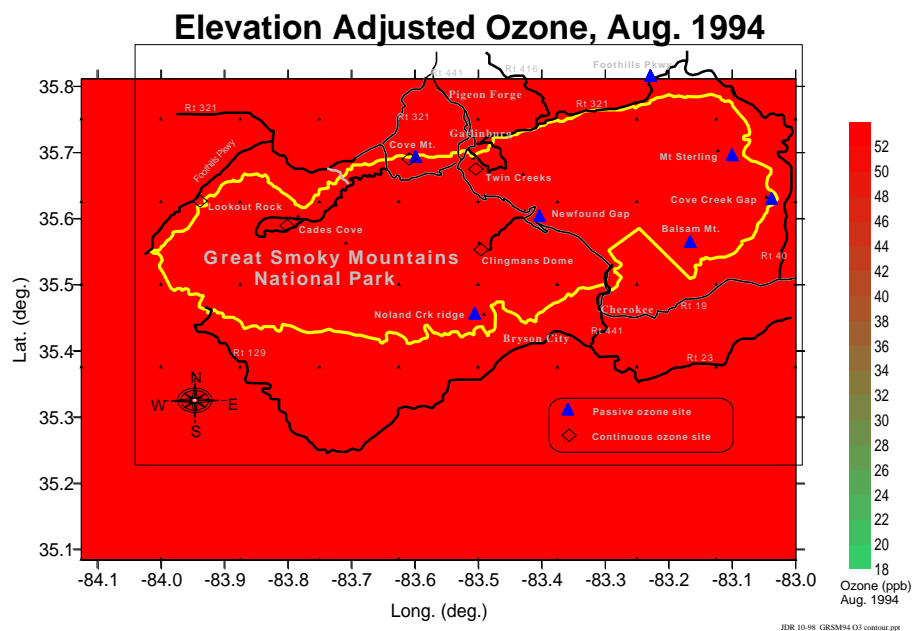


Figure 1 Estimates of ozone exposure over a three-week period in 1994 after applying a coarse grid of elevation data to correct the interpolated ozone values between observation sites. (Ray, 1999)

Other researchers have used a similar approach including Brace & Peterson (1), Liu (2), and Hogsett (3). The EPA EMPACT program currently publishes ozone contour maps for 8-hour periods at the AIRNow web site (<http://www.epa.gov/AIRNow/>).

### Proposed study

A coordinated study is proposed for the growing season in 2000 to measure ozone exposure within the park and to prepare GIS map overlays of the ozone SUM00 exposures. The ozone GIS overlay in combination with elevation and sensitive species overlays could then be used to determine specific areas at risk within the park from ozone pollution.

**Sample period:**

- Intensive measurement period July through September, 2000 (13 weeks)
- Spring growth period in May through June (8 weeks)
- Weekly samples as SUM00 measurements, coordinated day of sampler starts

**Sampling sites:**

- 30-50 sites including co-located samplers at 2-3 of the continuous monitoring sites
- mobile ozone analyzer to characterize hourly ozone concentrations at 6-8 of the passive sites
- aircraft overflights and vertical profiles of ozone by the ETOS program during the study
- high overlap with the spatial study of forest throughfall of NO<sub>3</sub> and SO<sub>4</sub> deposition
- inclusion of 8 continuous analyzer monitoring stations

**Proposed data analysis:**

- ozone-season SUM00 contour map as a GIS overlay using Kreiging for interpolation between sample sites
- Combined measurements for "growing season" SUM00 contour map
- Weekly and variability ozone maps to determine primary periods of ozone exposure
- Calculated ozone-exposure map overlays adjusting for elevation, aspect, and edge-effects in the interpolation between measurements sites
- Elevation and transect graphs of the ozone exposure for selected locations

**Other data for comparison and analysis:**

- Weather maps and model predictions for temperature, winds, etc.
- Air mass back trajectory analysis to several locations within the park
- AIRNow ozone maps for comparison and understanding of regional ozone

**Cooperating staff:**

- Field study to be conducted by GRSM air quality staff, rangers, and researchers with the assistance of a volunteer hiking group, and ARD staff.
- Coordinated activity with other researchers from NOAA (ETOS) and TVA.
- GIS assistance from GRSM and ARD staff (and possibly others - student intern for example)
- Data processing and non-GIS analysis by ARD staff

**Funding:**

- Field support and laboratory analysis funded by ARD (\$35,000)
- Staff time - GIS and data processing, field operations (\$15,000 - 25,000)
- Volunteer help - (valued at ~ \$25,000)

**Schedule:****2000**

Jan-Feb	Planning and study design development
March-April	Build sampling equipment, revise SOP and logsheets for study, preliminary site maps, contracts for analysis, preparation of GIS prelim maps of elevation, aspect, sensitive species
April	Confirm monitoring sites and prepare final maps
May-June	Deploy ~20 "growing season" sites and start passive sampling
July-Sept.	Intensive study using passive sampler and mobile instruments
Oct.	Ozone results back for July
Nov.	Ozone results from August
Dec.	Ozone results from September

**2001**

Feb.	SUM00 ozone provided to GIS analysts
April	Map overlays available for review and study
May-June	Prepare report and draft of journal article